Journal of the Society of Arts.

FRIDAY, OCTOBER 19, 1866.

Announcements by the Council.

Examinations, 1867.

The Programme of Examinations for 1867 is now published, and may be had *gratis* on application to the Secretary of the Society of Arts.

In addition to the prizes offered by the Society of Arts, the Worshipful Company of Coach and Coach Harness Makers offer a prize of £3 in Freehand Drawing, and a prize of £2 in Practical Mechanics, to the candidates who, *being employed in the coach-making trade*, obtain the highest number of marks, with a certificate, in those subjects respectively.

Proceedings of the Society.

CANTOR LECTURES.

"On the Synthesis and Production of Organic Substances and the Application which some of them Receive in Manufactures." By Dr. F. Crace Calvert, F.R.S., F.C.S., &c.

Lecture III.

Delivered on Friday, April 20th.

On the Transformation of Organic Acids and Neutral Substances.

Among the various subjects which I had the pleasure of bringing before you during my last lecture, I referred to the curious fact that, when 70 parts of alcohol are carefully mixed with 100 parts of strong sulphuric acid, and the whole is left together for twenty-four hours, and then submitted to a heat of 284° Fahrenheit, the alcohol which it contained unfolds itself into ether and water; and that when once this action had taken place, as Liebig and Mitscherlich observed, any further quantity of alcohol added unfolds itself into ether and water, and this peculiar action continues; that we were bound, therefore, to conclude that the acid fluid in the retort had the power to unfold alcohol into the substances above stated; and that this class of action had received the name of catalytic action, or action of contact. These classes of chemical phenomena are so important, not only in a scientific point of view, but also in a practical one, and they are called upon to unravel to us such important and useful results, that I am sure you will excuse me if I take the liberty of bringing before you one or two more instances, so that you may have a clear insight into those peculiar classes of chemical action, and be able to distinguish them from other series of chemical facts which, at first sight, appear identical, but which, in reality, differ widely when closely examined. I cannot do better than describe the first case of catalytic action which was observed in science by the late eminent chemist Mitscherlich. If in two retorts of the same diameter is introduced chlorate of potash, and in one of them 10 per cent. of oxide of copper is added, and heat applied to both retorts the following facts will be observed:—In the retort containing only chlorate of potash the salt will melt when it has reached a temperature of 400° or 500°, and give off oxygen; the action then will subside, and if the temperature be slightly raised to 600° or 700°, then torrents of oxygen will escape, and, unless care be taken, some of the peaty mass of chloride of potassium will rise in the cold neck of the retort, break it, and allow the mass to escape, and therefore great care must be taken to avoid accidents. But if heat be applied to the retort which contains chlorate of potash and oxide of copper, oxygen will be liberated at a far lower temperature, and its production can be regulated with the greatest facility; the chlorate of potash does not enter into fusion, and the mass remains solid. If the product left in the retort is examined after the whole of the oxygen has been liberated, chloride of potassium will be found in both retorts, and the oxide of copper will be found in the same state as it was before it was mixed with the chlorate of potash. Therefore, this substance has undergone no change, but still it has completely modified the *modus operandi* of the decomposition of the chlorate of potash. From these facts we are justified in coming to the conclusion that the oxide of copper has acted, either by its contact with the chlorate of potash, or by a peculiar force or property which has received the name of catalytic force. This simple instance of catalytic action will enable you to appreciate more fully the following one, due to M. Berthelot, and which presents much interest, owing to the fact that it has placed at our disposal, in such quantities as to render it a commercial article, a product which I mentioned in my first lecture, and also in the last one, I mean formic acid, which, if you remember, was produced in the first instance by placing some platinum black in a watch-glass which was suspended over a vessel containing wood naphtha, the whole being covered with a bell-jar; and I further stated that the platinum black, having absorbed, condensed, and I might perhaps say liquefied, in its porous texture, the oxygen of the atmosphere, brought it into such a state as to unite with the vapours of the wood naphtha as they arrived in their turn on the surface, and by oxidising them, to convert them into formic acid. The next example was the production of formic acid by acting upon sugar with a mixture of sulphuric acid and peroxide of manganese. The mode of production to which we are now going to refer, is due, as above stated, to catalytic action. It consists in heating a mixture of glycerine and oxalic acid, when the latter substance unfolds itself into water, formic and carbonic acids, as shown by the following formula:—

$$C_4\,H_2\,O_8\,4\,HO = C_2\,H_2\,O_4 + 4\,HO + C_2\,O_4$$

If then water be added, and the temperature raised, formic acid distils, and, notwithstanding these chemical decompositions of oxalic acid, the glycerine has undergone no change.

M. Lorin has investigated closely this catalytic action, and has published lately a most interesting paper on the unfolding of oxalic acid in contact with glycerine. He has observed that if in a retort glycerine is heated to 180°, and oxalic acid is gradually added to it, every successive quantity added will unfold itself in accordance with the above formulæ. The consequence is that with a few pounds of glycerine several hundred weights of oxalic acid can be unfolded into formic and carbonic acids, *plus* water. He has further observed that if instead of taking oxalic acid such as is found in commerce, and which is composed of one chemical equivalent of oxalic acid united with three equivalents of water, he takes the same acid and heats it gently, so as to drive from it two proportions of water out of three that it contains, and that if then he adds this modified oxalic acid to some heated glycerine, he gets a very strong solution of formic acid, in fact one which contains 75 per cent.

Before parting with the interesting subject of catalytic actions, let me call back to your memory a most interesting series of facts which I described to you in my first course of Cantor Lectures, and which had reference

to Belmontine candles and other fatty acid products, manufactured by Price's Patent Candle Company, under the superintendence and by the processes discovered and perfected by the talented Mr. George Wilson, F.R.S. No doubt you will remember, without my again entering into details, that this valuable process consists in unfolding fatty matters into acids and glycerine under the influence of heat and sulphuric acid, and that I drew your special attention to the curious fact that he had gradually decreased the proportions of vitriol until he had succeeded in unfolding fatty matters into the above substances by means of two or three per cent. of sulphuric acid with the aid of a temperature of 560°, and that he had succeeded in removing from the still in which the decomposition took place the fatty acids and theglycerine by means of superheated steam having a temperature of 560°. In my opinion the unfolding of fatty matters into fatty acids and glycerine under these circumstances, viz., by a few per cent. of sulphuric acid, must be referred to a catalytic action, the amount of vitriol being so small as compared with the amount of molecular work effected under its influence.

I shall now have the pleasure of calling your attention to the artificial production of a beautiful and useful acid called benzoic, which has acquired of late years much interest, owing to the fact that it has been used in the production of aniline colours, especially blues and purples. Benzoic acid presents itself under the form of white brilliant prismatic needles, slightly soluble in water, but freely so in alcohol, and although it is inodorous when quite pure, still, generally speaking, it has an agreeable aromatic odour. It is found abundantly in nature. Thus it has been observed to exist in the pods of vanilla, in the bark of the birch tree, of the *Calamus aromaticus*, and also in that of the *Guiacum officinale*, and in several varieties of mushrooms. But it is principally found in large quantities and extracted from gum benzoin by the following process: — Some of the pulverized resin is mixed with sand, and the whole is placed in a small earthenware vessel, covering it first with a sheet of filter-paper, and surmounting the whole with a paper cone, and applying a gentle heat, when benzoic acid will be converted into vapour, sublimated and condensed in the cone under the form of fine brilliant needles which only require to be collected. Benzoic acid can also be obtained by boiling gum benzoin with a milk of lime; soluble benzoate of lime is produced, which is removed from the excess of useless resinous matters, and on the addition of an acid to the benzoate of lime in solution, benzoic acid is liberated and crystallizes.

Allow me to lay before you two or three curious instances in which benzoic acid is produced, and which have a special interest, as the sources from which it is derived differ widely one from another. The first instance is its production from the essence of bitter almonds, which is generated when bitter almonds are crushed and mixed with warm water; the peculiar ferment which they contain, called emulsin, acts upon a white solid crystalline body, amygdaline, and unfolds it into hydride of benzoyl, formic and prussic acids, which mixture is called the essence of bitter almonds, and which, as I have told you, I believe, on some former occasion, should be used but sparingly for culinary purposes, in consequence of the prussic acid it contains. When essence of bitter almonds is exposed to the atmosphere the hydride of benzoyl absorbs oxygen, and is thereby converted into benzoic acid.

The second source from which benzoic acid can be derived is widely different from that which we have just been examining, for it is obtained from the urine of herbivorous animals, by allowing the same to ferment, and then boiling it with hydro-chloric acid, when, after concentration, it yields benzoic acid, although this acid does not exist in the urine already formed. It is derived from a substance which is always a component part of the urine of herbivorous animals, and which has been named by Liebig hippuric acid. This acid represents in the urine of the animals the urea found in that of man, and the uric acid existing in that of the carnivorous animals, reptiles, and birds. All these substances are nitrogenated, and may be considered as products resulting from the decomposition of tissues destroyed by the wear and tear of life, and which have to be removed to give room for the formation of the new tissues, which are constantly being formed to maintain vitality, and these refuse products are slowly and gradually oxidised during their passage in the blood, and are thereby transformed into hippuric acid, urea, and uric acid; therefore it is the hippuric acid which exists in the urine of herbivorous animals that yields, under the influence of hydro-chloric acid, benzoic acid, and a nitrogenated substance called glycocoll. What will, I hope, carry to your minds the conviction that benzoic acid is a derivative from hippuric acid, is the fact that Dr. Stenhouse some years ago took some benzoic acid, and was able to trace the presence of hippuric acid in secretions of his kidneys, leaving no doubt that benzoic acid could be converted into hippuric. Two or three years ago, the demand for benzoic acid being rather large, induced several chemists to try to discover a cheap method of producing it. After a few months' labour, Messrs. Depouilly succeeded in obtaining it from a coal tar refuse, the only one which, up to that time, had not received any useful application in arts and manufactures. They arrived at these useful results by a series of chemical transformations, which I propose now to lay before you. They take the white crystallised substance called napthaline, which they convert into bi-chloride of napthaline by acting upon it with a mixture of chlorate of potash and muriatic acid. This product once obtained and isolated is converted, by the action of nitric acid upon it into a white substance, called phthalic acid, which, in its turn, is mixed with lime, and the mixture, on being heated at a temperature of 662° Fahr., unfolds itself into carbonate and benzoate of lime. It is only then necessary to act upon these products with hydro-chloric acid when chloride of calcium is formed, carbonic acid escapes, and the benzoic acid dissolves in the water, from which it is easily extracted.

I cannot leave this part of my lecture without referring to the interesting fact that if napthalin is acted upon with nitric acid, it is gradually transformed into phthalic acid, and that the same product is obtainable when the colour-giving principle of madder called alizarine is submitted to the same action, which leads us to surmise that there is a connection between napthalin and the colour-giving principle of madder roots.

Every person in this room is no doubt well acquainted with a white crystallised substance called tartaric acid, which is extracted from cream of tartar, and is a product of vinous liquors when allowed to "age," and which constitutes what is called the "crust" of wine. As tartaric acid is extensively used in calico printing, to obtain steam blue and greens, by mixing it with prussiate of tin, and also for making seidlitz powders, as well as a substitute for yeast or barm in the manufacture of bread when added to carbonate of soda, the price of the article often reaches a comparatively high figure. Great efforts have, therefore, been made to produce this acid artificially. Baron Liebig published a few years ago a simple process to obtain tartaric acid, but though interesting in a scientific point of view, it has not, to the best of my knowledge, been adopted by manufacturers. It consists in acting with nitric acid on sugar of milk, or lactarin, a substance which I told you in my last year's lectures exists in large quantities in milk. When tartaric acid is fused with caustic potash it unfolds itself into oxalic and acetic acids, as shown by this formula:—

$$C_8\,H_4\,O_{10},\ 2\,HO + 3\,(KO\ HO) =$$
Tartaric acid. Potash.

$$KO\,C_4\,H_3\,O_3 + 2\,KO\,C_4\,H_6 + 3\,H_2\,O_2$$
Acetate of potash. Oxalate of potash.

As oxalic and acetic acids are easily obtainable from sugar, and as sugar in its turn is easily procurable from starch, and as starch is isomeric with fibrous matters called lignin, you will, from the chemical knowledge you have now acquired of the transformation of one organic substance into another, very easily conceive how tartaric acid can be derived from the vegetable kingdom.

Allow me to dwell for a few minutes on the artificial production of an acid called aconitic, and which is found in nature to exist in the aconite or wolfbane—a plant which from its beautiful flower is one of the ornaments of our gardens. Aconitic acid is produced artificially from an acid well known to all of us, called citric acid, which exists in large quantities in oranges, lemons, &c., and which is used extensively for preparing lemonades, and also in our print works as a discharge or a reserve—that is to say, to reserve on a piece of fabric white spots or white designs, or, in other terms, to prevent that part of the fabric from being coloured. It is also employed, as I have stated, as a discharge; I mean to remove from dyed calico fabrics certain portions of colour. The white designs on black pieces of calico are generally produced by this method. To convert citric acid into aconitic, all that is necessary is to maintain citric acid at a temperature of 266° for a short time, when it loses two chemical proportions of water and becomes converted into aconitic acid. Citric acid is also susceptible of another conversion. Dr. Phipson, by acting with a solution of permanganate of potash on one of citric acid, has succeeded in converting it into acetic and succinic acids—the latter being an acid which a few years since was only obtainable through the destructive distillation of amber, a peculiar mineral, found principally in lime formations, and much employed, as you are aware, in the manufacture of fancy articles. Succinic acid can also be obtained by allowing the mountain ash berries to enter into fermentation for a few days, when the malic acid which they contain is converted into succinic acid; but the principal source from which chemists at the present day obtain succinic acid, much used in chemical analysis, especially to separate iron from other metallic oxides, is by acting upon olive oil with nitric acid, when, among other products generated, succinic acid is formed.

Permit me now to dwell on the transformations of another organic acid, malic acid, found abundantly in nature, more so, in fact, than either tartaric or citric acid, and which exists in a great number of plants, among which may be cited rhubarb, apples, pears, and consequently cider, &c. If it is less known than tartaric or citric acid, this is due to its being a liquid and its extraction difficult and uncertain, and when obtained it does not present that sightly appearance necessary to render it a mercantile article. Notwithstanding the difficulties attending its extraction, chemists have succeeded in converting this acid into two solid acids found in nature, one called equisetic, extracted from the equisetum, or mare-tail plant, and also into fumaric acid, easily obtained from the common fumatory. To convert malic acid into fumaric acid all that is required is to heat malic acid to a temperature of 266,° when, strange to say, the malic acid absorbs no elements nor loses any, but each equivalent of this acid unfolds itself into two equivalents of fumaric. To produce equisetic acid, malic acid is heated to a temperature of about 280°, when it loses two equivalents of water, and becomes converted into equisetic acid. If to malic acid you add dry ammonia, you obtain a substance called malamide, which is isomeric in composition, with one found abundantly in nature, which is white, crystallised, and tasteless, and which bears the name of asparagin, being easily obtained by concentrating the expressed juices of asparagus, liquorice root, marsh mallow root, and potatoes, and which is also produced under the following curious circumstances, namely, that if peas are grown in the open air neither they nor the plant contain asparagin, but if they are allowed to germinate in the dark this substance will be found in the young shoots.

There is the artificial reproduction of a substance to which I shall briefly allude; it is one which chemists have much admired, not only in consequence of the scientific methods which have been devised to obtain it, but because it was the first reproduction of an organic matter which itself was the result of the decomposition of others under the influence of vital action, that is urea, which is one of the most important substances generated in man. Urea exists in the proportion of 400 or 500 grains in the daily secretion of the human body, and is the chief product resulting from the modification which animal matters undergo when they have fulfilled their appointed functions in the human body, and have been destroyed by the tear and wear of life, and have to be replaced by the new cells of fresh tissues. Urea is a white substance, crystallising in well-defined prisms, soluble in water and alcohol, which, under the influence of a peculiar ferment which accompanies it in the secretion of the kidneys, unfolds itself with facility into carbonate of ammonia by absorbing two equivalents of water, thus explaining the pungent odour that the fluid of the kidneys acquires when kept and allowed to enter into fermentation. Wöhler was the eminent chemist who first reproduced from mineral elements, urea; and he effected this important result by acting on cyanate of silver with chloride of ammonium, giving rise to chloride of silver and cyanate of ammonia, or urea. But Liebig was the chemist who gave us a method by which we can prepare that substance in large quantities. It consists in heating on an iron plate a mixture of four parts of ferrocyanide of potassium with one part of peroxide of manganese, and after the mass has undergone a chemical action it is found to be a mixture of cyanide of potash, carbonate of potash, and oxide of manganese. If the mass is treated with alcohol, and sulphate of ammonia added, sulphate of potash is produced, and falls as an insoluble body, whilst the cyanate of ammonia or urea remains in the solution, and can be obtained under the form of well-defined crystals, which are identical in appearance and properties with those which can be obtained from the daily secretions of man.

In connection with this subject there is a series of facts which deserve our peculiar attention, as they offer to us a remarkable example of organic substances differing widely in their properties, and in their relations to each other, although built out of the same elements and in the same proportions. Thus Baron Liebig and Wöhler published, some years since, the following curious and interesting instance where they showed that, by the grouping of the same elements, the three following curious substances were produced:—

Cyanic acid....	$C_2\ N\,O + H\,O$	or	$Cy.\,O + \ H\,O$
Fulminic acid..2	$(C_2\ N\,O + H\,O)$	or	$2\,Cy.\,O + 2\,H\,O$
Cyanuric acid..3	$(C_2\ N\,O + H\,O)$	or	$3\,Cy.\,O + 3\,H\,O$

By this diagram you will observe that fulminic acid only differs from cyanic by the elements being doubled, and that cyanuric contains the same elements, only they are tripled. But these interesting facts are not confined to a mere play of chemical formulæ, as they represent substances which are widely different in their properties. Thus cyanic acid is a transparent liquid, extremely volatile, having a most powerful and pungent odour, and acting as a violent caustic when brought in contact with the human skin, producing blisters and most intense pain. This substance, however, when kept for a short of time, undergoes a molecular change, and becomes a solid, which does not possess any of the caustic proeprties of its Protean father.

Cyanuric acid, on the other hand, is a solid, which has no odour, but has a slight, feeble acid taste, and is only sparingly soluble in water, and is often produced when organic matters are decomposed under the influence of heat. Fulminic acid does not exist in a free state. We only know it as combined with metallic oxides, and the most remarkable compound known to us is the fulminate of mercury; that is to say, the substance which, when mixed with a little nitre and gum, fills up the percussion caps, so extensively used at the present day in warfare. To produce fulminate of mercury, one part of mercury is dissolved in twelve parts of nitric acid, to which are added eleven parts of alcohol at 80° of strength. After a short time a most violent chemical reaction ensues, the result of which is to give birth to white opaque crystals of fulminate of mercury, which only require to be separated and dried to constitute that substance. It is certainly interesting to reflect on the fact that bodies having such widely different properties, and which may be derived from such widely different sources, should all have a similar if not an identical chemical composition. In fact, every 100 parts of them contain the same amount of carbon, nitrogen, and oxygen, and they could not have been distinguished in this respect had it not been for the eminent labours of Liebig.

I cannot part from you this evening without drawing your attention to the artificial production of a substance called allantoin, discovered by Vauquelin and Buniva in the amniotic fluid contained in the amnios membrane of the cow. This result was obtained a few years since by Wöhler, in acting on a substance well known to you at the present time from the remarks I made upon it last year, and found in small quantities in the urine of man, but in large quantities in the urine of carnivorous animals, and constituting almost entirely the excrements of birds and reptiles—namely, uric acid. Wöhler, by oxidizing uric acid with peroxide of lead suspended in water, produced a white crystallised substance, which proved on investigation to be that which Vauquelin and Buniva had found many years previously as a product of vitality; and I am certain you will not be surprised when you reflect on the origin of this substance, especially in a chemical point of view, to hear that it can be unfolded into urea, of which we have just been speaking, and into an acid called allanturic, a second product of decomposition.

These series of facts must at once convince you how deeply chemistry is penetrating into the field of medical science, and what an immense service it promises to render to therapeutics and physiology, as it developes itself, and inquires more deeply into the phenomena which take place in the human body. But it is much to be regretted that so few men devote their attention to that branch of inquiry, There are not at the present time in Europe more than half-a-dozen medical men, such as Bence Jones and Marcet in England, Bischof in Germany, Claude Bernard in France, who may be cited as brilliant examples of what so many of their colleagues ought to imitate.

Proceedings of Institutions.

Gainsborough Mechanics' Institution.—On Thursday, the 11th instant, the annual *soirée* took place in the Priory Hall, Captain Challoner, R.N., president, being in the chair. On the platform were the chief residents of the district, and the hall was well filled. Special addresses were delivered by Mr. J. W. Pease, M.P., and Mr. Henry H. Sales.

Northallerton Mechanics' Institution. — The annual meeting was held in the Court House, on Monday evening, the 8th instant. The chair was taken by Lord Teignmouth. The report was read by Dr. Walton, jun., and directed attention to the steady progress made by the Institution. An address was given by Mr. Henry H. Sales, on " Helps for Working Men."

FACTORY SMOKE.

At the meeting of the Social Science Association at Manchester, the following papers were read:—

Dr. Angus Smith, F.R.S., remarked that warm interest had compelled him for many years to attend to the condition of the air of towns. Habit had no power of rendering smoke pleasant. Few men living in a smoky town required to be convinced that they were in the daily endurance of a monstrous evil. Many substances made their appearance as smoke from chimneys; that to be now considered was coal smoke. Some time ago he calculated that sixty tons of carbonaceous matter were sent off in a day into the atmosphere in Manchester. A very small amount affected the atmosphere; a grain, or 18 cubic feet, was sufficient to convert good air into Manchester air, so far as carbon was concerned. About one-half the colour was due to tarry matter, and the other half to black carbon only. Dr. Smith continued:—This black matter is the colouring material of all our smoky towns, and, to a great extent, of the clothes, as well as of the persons, of the inhabitants. We live in houses coloured by it, and we walk on roads coloured by it, and we can see the sun, the moon, and the heavens only after they have been, to our eyes, coloured by this universal tincture. These are calamities of themselves; but, although some men would look on such a view of the case as mere sentiment, not one amongst us can fail to have his spirits tinged with the darkness of the sky. I found this strangely corroborated lately. One of the best men of business in Manchester informed me that on an atmospherically dull day no one would give a high price for goods, no one had the courage to give it; but on the other hand they could buy goods at a lower price, the seller had not the courage to hope for better. These dull days are caused in part by the climate, but their remarkable oppressiveness is unquestionably due in great part to the smoke. We do not consider that by the smoke we make we are affecting our own spirits and clouding our own judgment. It is my belief that this effect on the spirits is the most powerful of all objections to smoke, even in the minds of those who believe themselves above such feelings. There, is, however, no denying the great fact that everything coming in contact with a smoky atmosphere is so blackened that cleaning becomes difficult or impossible. Smoke gives to every household it visits, either a greater amount of labour or a lower social appearance. Dr. Smith proceeded to show that the poor paid directly for the smoke, living where it prevailed, and that the middle-classes and the wealthy suffered proportionately in being compelled to live out of town, and to spend time in going to and fro. Dr. Smith remarked that it was quite true that carbon, tar, and sulphuric acids were disinfectants; but we did not wish to breathe them constantly—we could not live on medicines. The disinfecting power of smoke had not rid us of disease, nor did it prevent occasional pestilences. If it did good, it did more evil, and much of the mortality of Manchester must be attributed to smoke. It had been said that if the carbon was thoroughly burned the amount of sulphurous acid would be so great as to be intolerable; but when the blackness was removed the sulphuric acid seemed to escape more easily. The very stones decay under the constant action of acid, and the bricks crumble more rapidly. Even in places less troubled with smoke, we see the decay. The Parliament Houses, built to remain for ages, are rapidly, before our eyes, turning into plaster of Paris and Epsom salts. Probably some of the evil might be avoided. The finest buildings in London appear less handsome than flimsy structures in many continental cities. With us, the peculiarity of the climate is a great enemy. On certain days the acids rise rapidly; but, as a rule, they fall. Great extremes of dryness and of rain are the best protectives, and, during heavy showers, the air of Manchester is not unpleasant to breathe, because the sulphur

is carried down on the rain. One of the foremost printers of Lancashire told me that there were some colours which he found almost instantly to fade. They were frequently sent back upon his hands. He was annoyed to find that the French sent the same colours to the same markets without the risk of having them returned, and it was only after much time and loss that he found that the goods must not be allowed to pass through Manchester. One day was enough, but in some weather two hours were sufficient for their deterioration. The only sure mode we know of diminishing the amount of acid given out by chimneys is by burning no sulphur. This can be done, perhaps, to some extent, by burning less coal, and burning it more economically; next, by not allowing the most sulphurous of the coals to be burnt in large towns. This latter is a simple mode of doing some good, and cannot in all cases be considered too great a demand on manufacturers. Dr. Smith would not speak of the means of burning smoke, which some years ago numbered twelve dozen. It would be a cause of great gratification if the movement began with an association of manufacturers. Municipal bodies had failed to produce any important reform. We must remember that we could not live without rendering the air impure, and, rich as the country might be, we could not afford to destroy our manufactures in order to preserve the beauty of our fields. In such cases there must be compromise. We should oftener arrive at the truth if these questions were considered from wider points of view.

Professor Crace Calvert, F.R.S., read a paper on the same subject. Dr. Calvert said:—The action of the products of the distillation of coal upon vegetation varies a great deal according to the circumstances under which they have been produced; thus, the products of the perfect combustion of coals may be represented by carbonic acid and water with small quantities of nitrogen and sulphurous acid, all of which are invisible gases, having no action on vegetation except sulphurous acid. But if coals are introduced into a gas retort and heat applied the products given off are numerous, chemists having already isolated and characterised more than 30 distinct substances, many of which are most destructive to both animal and vegetable life, being highly poisonous when administered in even minute quantities; therefore, the products obtainable from coals vary enormously according to the circumstances under which they are produced. The above statement will enable us better to understand what is commonly called "smoke," and the reasons why it varies so considerably in composition. Thus the smoke issuing from the chimneys of private dwellings may be considered on the whole as belonging to the class where perfect combustion occurs, for the gases, as they emerge from the chimney, carry with them only carbonic acid, carbonic oxide, and sulphurous acid, and a small quantity of the most volatile hydro-carbons which are given off, and this only takes place at the time and shortly after the coals are freshly added to the fire; the less volatile products being condensed in the flue of the chimney, forming what is called soot; but as soon as the volatile products (which are characterised by burning with flame when coals are put on the fire at first) are consumed, the carbonaceous mass which remains in the fireplace may be considered as undergoing perfect combustion, and emitting, as stated above, only gases, having little or no action on vegetation or man, more especially when they become diffused in the atmosphere. But the results of burning coals under the steam boilers employed in our large factories are very different.

1st. Because coals are constantly being added to the mass in combustion. There is not, consequently, that cessation of the distillation of tarry products above stated, as taking place in the fireplace of private dwellings, and it follows that the products of perfect combustion, which are generated near the grates of the fireplaces in factory furnaces, are constantly mixed with a considerable quantity of tarry substances produced by the distillation of the coals, and therefore through their imperfect combustion.

2nd. As stated above, in the chimneys of our dwellings, the draught is such as to permit many of the imperfect products of combustion, or most of the tarry products, to condense, whilst in the tall chimneys erected in our factories the draught is such as to carry out from them the above noxious volatile products; and as many of them will easily condense into liquids and solids when they come into contact with a cold atmosphere, they cannot diffuse nor be carried far before they fall upon plants and other bodies existing in the neighbourhood of such chimneys, and as many of the tarry products are highly poisonous to plants, they affect vegetation in a very marked manner.

3rd. "Black smoke" is a mixture of the products of the imperfect combustion of coal with carbon in a high state of division; the solid particles of carbon when floating in the atmosphere become, like all solids, centres of attraction for fluids, and thereby assist in the condensation of the liquid and poisonous products above mentioned, and help to carry and fix them on the surrounding vegetation, which is characterised by a deposit of such products upon the surface of the leaves and bark of plants, which prevents that free contact with the elements of the atmosphere which is so essential to their health and growth; for, as you are aware, plants absorb carbonic acid from the atmosphere from which their carbon is derived, and they reject oxygen and watery vapour. Further, the intensity of these actions is in exact ratio with the intensity of light, and when "black smoke" is produced in large quantities it interferes with the rays of light arriving on the surface of the earth, and thereby affects vegetation materially. It appears to me that the above facts give an explanation of the activity of vegetation observed in London as compared with that witnessed in Manchester, Leeds, Sheffield, Birmingham, &c. I am well aware that the vegetation in these towns may be slightly affected by the large proportion of sulphurous acid which the smoke issuing from the factory chimneys contains as compared with the quantity of sulphurous acid produced by the consumption of a better class of coal in London, but sulphurous acid, like all gases, has such a high diffusive power, and the mass of air with which it mingles is so considerable, owing to the high temperature at which it leaves the top of the high chimneys, that, although it may somewhat affect vegetation, still I consider its action is comparatively small in proportion to the injury effected by the fixation of "black smoke" upon plants, &c., as described above. As to the comfort which the inhabitants of our large manufacturing towns would derive from the perfect combustion of the fuel in our large mills, works, &c., no one can venture to say; at all events, as a matter of health and comfort, an opinion can be formed by comparing the state of the atmosphere in large towns like Manchester, on Sunday as compared with that which is witnessed on the other days of the week. It is hardly necessary to add that it is on record in evidence before a Committee of the House of Commons that manufacturers can effect a saving of 15 or 20 per cent. by burning their smoke, and it is most painful to reflect that after the weighty evidence which has been adduced by many of the leading manufacturers of Manchester, such as Messrs. Bazley, J. Whitworth, Henry Houldsworth, &c., before a Committee of the House of Commons some twenty years ago, we should still live in such a noisome, unsightly, and unwholesome atmosphere as that of this city; and lastly, to witness how Acts of Parliament are put on one side, when they are to be carried and enforced by local authorities who are in such cases the offenders, and at the same time the authorities called upon to inflict fines and punishment.

Mr. Peter Spence, F.C.S., read a paper on the same subject, in the course of which he said the black smoke of our manufacturing operations is, as one would

naturally imagine from the continual outcry made against it, the worst form of the evil; that in fact it is, all things considered, in a sanitary point of view, an evil at all, I am here to deny; and as I have for years made this a subject of thought and investigation, I think I shall be able to substantiate my opinion. If, in getting rid of black or visible smoke, we were at the same time to get rid of the products of combustion altogether, no doubt the advantage would be great; but if we only increase the quantity and intensify the power for evil of the invisible substances produced, the benefit is not apparent; and if by getting rid of visible smoke we merely get rid of a body not only inert for evil, but in other circumstances fully allowed to be a body of a health-producing character, then we not only do no good, we do positive harm. The facts are decidedly in the inverse ratio of the theory of the sanitary smoke consumers, but harmonise completely with what I believe to be a true theory, founded on a consideration of the nature and ordinary effects of the body with which we are dealing. Would it not be well, therefore, for our sanitary friends to leave this matter to the economist? While we have nothing to gain on the score of health by consuming our smoke, and may have something to lose, we have much to gain in the economy of our fuel.

Mr. HANDSEL GRIFFITHS contributed a paper, read by Captain Clode, one of the secretaries. Mr. Griffiths proposed, as a practical remedy, that the large chimneys of manufactories should be supplied with five or six diaphragms of wire gauze, the lowest to be easily removable, and to be placed at so great a distance from the furnace that the heat should not affect it. The second diaphragm was to be also removable, as, indeed, all of them, for the purpose of cleaning.

A very interesting discussion followed, in summing up which the Chairman said, that the extinction of the smoke nuisance on the rivers in London was due to Lord Palmerston, who, when a deputation waited upon him and said it was impossible to stop the smoke, said he would show them how to do it. They had now a Prime Minister who had begun in a somewhat similar way to deal with chimney nuisances; and he did not think that it was a glory of which Lord Derby would have occasion to be ashamed, if he delivered Lancashire from the pest of smoke.

THE TEACHING OF NATURAL SCIENCE.

The following is an abstract of a paper read before the Social Science Congress by Mr. John Angell, of the Manchester Mechanics' Institution, on Tuesday, October 9th:—

The author laid down the principle that the teaching of natural science should form a leading and fundamental part of juvenile education on the following considerations:—1. Because of its relation to the structure and organisation of the human mind. 2. Because it supplies that knowledge upon which human well-being, to be secure, must be based. 3. Because its proper study constitutes the best juvenile training for the actual business and duties of life; that is, it forms the best instrument for cultivating and strengthening the observing and judging faculties, upon the power and efficient operation of which mainly depends our progress in life. 4. Because it puts us into practical possession of the natural forces, the proper application of which supplies us with that abundance of the physical means of well-being which is absolutely necessary to the cultivation of our higher nature, constituting, in fact, a means by which the lower forces of heat, light, electricity, and chemical and mechanical force are transmuted into the higher form of mental force. 5. Because it puts us into possession of that comparative superabundance of the personal means of physical well-being and of leisure which are necessary for the elevation of the feeble and depraved among our own civilised race, and to the civilisation of the savage or barbarous races, that is, to the successful accomplishment of the true objects of philanthropic missionary enterprise. 6. Because it tends eminently to enlarge and liberalise the mind, to give it faith in the power of truth, and in the moral government of the universe, even in little things, and in the ultimate progress of the human race. 7. Because natural science is God's own exposition (revealed to us through the researches of the human mind) of the powers and agencies by which He regulates His providence in this world. In regard to the first point, he argued that the structure, organisation, and qualities of the human mind bear a similar relation to the forces which regulate the physical, intellectual, and moral world, that the bodily structure and organisation of one of the lower animals bear to its particular habitat in this world, and that intellectual and moral education, in its large and philosophical sense, consists in the conversion, under the influence of that divine gift, the human soul, of the various physical forces, including heat, light, electricity, and chemical and mechanical force, into the higher forms of vital, nervous, intellectual, and moral force. The fourth proposition he illustrated by showing the evil effects of sparse diet upon both the mind and the body, and the advantages to health, intellectual and physical well-being, which accrued from the application of natural science. History recorded no instance in which a people, permanently ignorant and destitute, had proved virtuous and happy. It was the duty of science to discover and invent, and that of commerce to multiply and diffuse, the gifts of science among mankind. The question arose, what branches of natural science should be more especially taught, and how? The three branches of science whose immediate training and practical value were the greatest were, in his opinion, chemistry, animal physiology, and social economy. On the data furnished by the two latter sciences might also very easily be taught or established a system of moral philosophy, which would do much to implant in the youthful mind an intelligent conviction that a selfish, untruthful, immoral, or sensual course of life cannot, under any circumstances, prove to be of real profit to the individual, or conserve his ultimate happiness, however powerful or influential he may become. In regard to chemistry he urged that the proper way to teach it was not by books, but by introducing the chemical bodies to the notice of the pupils, and causing them to ascertain by their own observation, and express in their own unaided language, the result of such observation. Previous to the performance of each experiment the teacher should see that the pupils had the clearest ideas possible to them at that stage of the proceedings, of the bodies on which, and the apparatus by means of which, he was conducting his experiments. He believed it to be a great mistake to suppose that young children are relatively deficient in reasoning power. The flood of questions with which they meet every new circumstance or phenomenon which is brought before their notice should be sufficient to dispose of this error. He concluded by commending the study of the natural sciences, and the importance of their teaching in juvenile schools, to the attention of those Christian gentlemen and philanthropists who worthily spend most of their lives in endeavouring to mitigate human suffering.

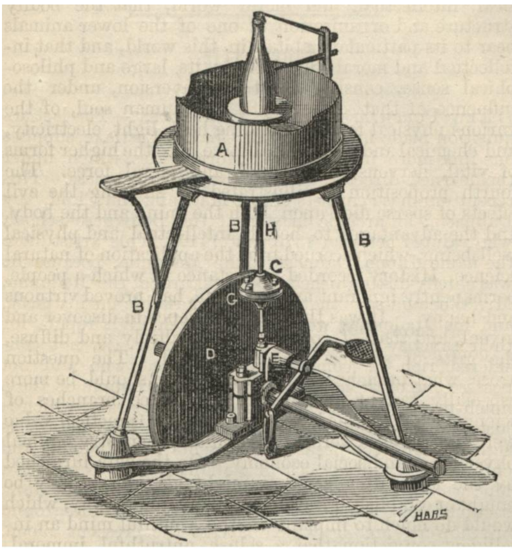
Dr. Lankester eulogised the paper, and warmly advocated the teaching of physiology in schools.

CLIFF'S IMPROVED WHEEL FOR POTTERS.

Mr. John Cliff, of the Imperial Potteries, Lambeth, has brought out an improved wheel for potters. He dispenses with all the straps, drums, breaks, pullies, &c., of the few steam wheels in use, and employs a system of gearing by contact only; the machine occupies but one-fourth the space now taken up by the present machines, and the boy to turn the wheel is not required. Instead of slackening speed by means of breaks, and

thus losing power, the slackening is gained by the reduction of pressure of G on the disc. The movement of G (by means of the foot lever) through the space of less than $\frac{1}{8}$ inch, secures at the will of the workman, every possible gradation of speed, from the full power of the engine to absolute stoppage. Though the screw shown is deemed the best arrangement, a plain lever is sufficient. When required, the entire machine may, by unscrewing the three legs securing it to the floor, be removed intact. The arm, table, and disc are all cast-iron, the spindle, with its pinion and foot movement, being the only parts requiring skilled mechanism.

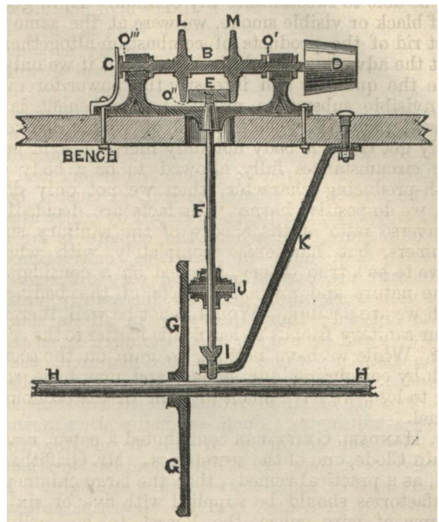
FIG. 1.



The following is a description of Fig. 1:—A, wheel box and seat, of galvanized or enamelled cast-iron, B, trident bar-iron legs. C, cast-iron bracket. D, cast-iron disc. E, quick thread lever screw for making contact. G, pinion of leather between iron discs, or wood, or metal. H, steel spindle, with longitudinal groove for the set screw of G to fasten in, and which for various sizes of work to be thrown, may be raised or lowered. The various speeds may be registered on the face of the disc, and the pinion placed there in less than five minutes.

Fig. 2 illustrates the application of the invention to an ordinary lathe. As in the throwing wheel, all ropes, straps, &c., are dispensed with, as well as the treadle-board and wheel, giving a neat and compact arrangement, and securing a large economy, as no boy is required to work the treadle of each lathe, as in ordinary work. In place of the stoppage of the wheel, and reversal of the motion of the rope for polishing clay wares, the workman, with his left arm on a small lever, moves B to the left, causing M to come in contact with the pinion E, which is in constant motion; and to stop, for change of pieces, he allows the spring C to push it back half the distance; while, if the spring is free, it will put L in contact with E, and give a cutting motion. In ordinary work every needful gradation of power is gained by more or less pressure of L or M on E, but in case great varieties of goods are required to be lathed on the same machine, the speed of E may be varied at once by dropping or raising J on the spindle, by means of a set screw; the support K may be placed at any angle, or dispensed with altogether, if the plummer blocks carrying the driving shaft are placed in vertical line with the spindle, the screw-step T being screwed into it. The certainty of the motion, governed at will by the workman himself, seems to promise a greater result of work in a given time, enabling the man also to earn, at given prices, better wages than he can do on the present system. If arranged for a double row of men, the same length of shaft will do, the discs being placed at half the distance as for a single row.

FIG. 2



The following is the description of Fig. 2.—A, is the ordinary lathe head, with under boss to allow of a long shoulder on F. B, cast-iron chuck spindle, with two discs. C, spring to keep at a cutting motion. D, ordinary chuck. E, driving pinion on head of F. F, a steel spindle, with grooves for set screw longitudinally. G, cast-iron disc in one piece, keyed on to H, the driving shaft. I, a screw footstep for F to run in. J, the pinion of wood, leather, or metal, or combined. K, support for spindle. L and M, two discs, either keyed on to B, or cast part of same.

SUGAR PLANTING IN NATAL.

The *Natal Mercury* says:—

Not long ago we were twitted with being presumptuous in venturing to throw out suggestions connected with the practical operations of agriculture. Journalists, we were told, ought to keep within the bounds of politics, or of social economics, and not attempt to treat of subjects which could only be dealt with by experienced men. Were that advice to be followed, we fear that the usefulness of a colonial newspaper would be wholly impaired, and its functions pitifully contracted to those of a mere recorder of events. There is no vehicle of discussion available except the paper. What other way is there of communicating information, or interchanging experience, but that afforded by the paper? We know that our country readers, as a rule, do look to the paper for hints and facts, if not for guidance. They might, it is true, do much to render the newspaper a more useful medium than it is, by sending more abundantly the results of their own observations and experiments. In the absence of these, the journalist has to do the best he can, and if he sometimes propounds strange theories the fault is not altogether his own.

When we say that Sugar-planting and Sugar-making in Natal, however, have to undergo vast changes before they can be considered as having attained even a comparative stage of the degree of excellence which it is possible to attain, we only repeat the oft-expressed opinions of disinterested and practical Mauritian planters. Natal planters are most of them men who began without previous knowledge of the pursuit, and who have acquired from others, from books, or from the hard and plain teachings of their own experience, the knowledge they possess. Under such circumstances it is self-evident that there must be wide scope for improve-

ment. Whether the statements of the observers we refer to are strictly correct, we cannot say, but there must be some ground for them. They say that there is a great waste of resources, that appliances and labour power are not economised as they ought to be; that much more ought to be got in the form of manufactured products, out of the raw material than is got. They admit fully the capabilities of the colony as a sugar-producing country. They admit the special advantages enjoyed by us in respect of cheap food, cheap land, cheap labour, and fine climate. But, say they, we do not make the most of these advantages. In Mauritius, where there is no abundance of land, where the whole of the available area is occupied; where labour and food have all to be imported; where the soil, exhausted by repeated croppings, has to be enriched by costly applications of manure, and where the climate is far more oppressive than ours—in Mauritius, cultivation and manufacture are carried on in a very different way. There mills work night and day, incessantly, until the crop is finished; there the syrup in all its stages is boiled over and over again, until the mere dregs are left for the distiller; there fields are manured, the soil husbanded, and every appearance of a weed abolished; there steps are taken to reduce the cost of transport to the lowest minimum. Such, and many other means, are named by our censorious friends from Mauritius as points wherein they are diligent, and we are lacking. We dare say in some respects they are right. Rome was not built in a day, nor has Mauritius cultivation reached its present state of perfection in ten years. When sugar-planting was as old in the island as it is in Natal, we suspect that it was in no more advanced condition than it is here. When Natal planters have been at work as long as the Mauritius planters, we do not doubt they will be able to tell as good a tale. Still we must not be too proud to learn, for that there must be many shortcomings in our modes of culture, and in our systems of management, is undeniable. Sugar-planting is an art which can only be understood, and properly practised, after a due apprenticeship.

It seems such an important matter to acquire the best information that is forthcoming in conection with the production of our leading staple, that we suggest whether some steps should not be taken by the planters to obtain, in a portable form, the results of the observations of experienced Mauritians. Whether many estates are yet prepared to bear the expense of employing an imported manager we know not, but many such are to be had at a moderate rate of remuneration. Hosts of young creoles could probably be induced to come here were they guaranteed reasonable salaries. Representations made in an authoritative manner through some influential Mauritian channel would succeed in bringing over the class required. These men are born sugar-planters; their childhood and youth have been passed amongst cane-fields and fabrics; they have lived in a saccharine atmosphere, and the pursuit is almost an instinct. We believe that the introduction of such aids would materially promote the development and the profitable working of our estates. Then it would also be posssible by combined contributions, to obtain the inspection of a high class Mauritian planter, who might, after visiting the various plantations, and making himself acquainted with the circumstances of the country, place on record the conclusions he had arrived at, and specify recommendations regarding the practical details of the enterprise. If these were printed, every planter, present and to come, might have them in his hand.

Beneath the pressure of the times, and harassed by the monetary difficulties begotten by the late crisis, planters may accustom themselves to the belief that their troubles are all of a financial kind, and can only be met by one species of relief. May we submit that there may be also other ways of guarding and providing for the future? May it not be possible to reduce expenditure, and to increase revenue? Do the estates yield all that it is possible to make them yield? Are their productive powers exerted to the fullest pitch? Could the labour power at command not be made to produce a larger harvest than it does? Progress, we have lately been told in election addresses—progress is the watchword of the age. All things are moving on. Every industry is undergoing improvement. Sugar-planting, too, shares in the onward movement. In times past, with none but imperfect means at hand, our planters did their best, and could do no more. Now that they feel their ground, and that more extended facilities are accessible, it would be a pity if the prospects of a fine industry were to be compromised by any neglect of opportunities.

Fine Arts.

New Purchases: National Gallery.—The last acquisition made by the late Sir Charles Eastlake, supplies one link more in the early historic series which, under the learned director, grew to rare completeness. This recent purchase consists of a "Madonna and Child," by Dalmasio, an archaic master of the Bolognese school, who painted between 1376 and 1410. This artist bore the name Lippo Dalmasio dalle Madonne, because he was chiefly distinguished for his pictures of the Madonna. Mr. Wornum says that he was remarkable for his piety, and his Madonnas were held in such high repute for their sanctity of expression, that a man was not considered rich or completely established who did not possess one of these pictures. It is an example of these much-prized productions, now extremely rare, which is just added to the National Gallery. The picture is signed. The composition represents the Madonna and child seated mid an orb of radiant glory; behind is a blue background or sky, set with a corona of gold stars, occupied by attendant angels. On the foreground are flowers, among which is cast the crescent moon. Another recent purchase is also a picture by another rare and early master, Pietro della Francesca, of whom our Gallery will now contain three examples. The work just added is a single head of a lady in profile; it may have been painted about the middle of the fifteenth century, and resembles the portrait of Isotta da Rimini, the wife of Sigismondo Malatesta. The painter, Pietro della Francesca, received a scientific education, and was one of the first artists who studied the laws of perspective. A third and a fourth purchase are a couple of companion pictures, belonging to the school of Melozzo di Forli, an artist of the second half of the fifteenth century, allied in style to the before-mentioned Francesca. These companion pictures were purchased by the present director from Mr. Spence, of Florence, for £600. Messrs Crowe and Cavalcaselle describe one of the compositions as follows:—Mr. Spence "owns a panel which formerly belonged to Signor Conti, at Florence, and is supposed to have been originally in the sacristy of Urbino Cathedral. A throne is occupied by a female; a small organ lies at her side, to which she points as she presents a book to a youth kneeling in front of her." The figure is supposed to personify the art of music. These trusty historians add that "It is needless perhaps to remind the reader that none of these creations are by Melozzo, but they illustrate the course of a particular form of art in a particular place." Mr. Wornum will, doubtless, in the next edition of the catalogue, further elucidate the subject, and identify the authors of these interesting though comparatively unknown examples of Italian art. The great prize, however, won by the new director is a *chef-d'œuvre* by Rembrandt, "Christ Blessing Little Children." This picture, for which £7,000 has been paid, was thrown into the market by the recent troubles in Germany. From time immemorial it belonged to the Gallery of Schönbrun, in Vienna; subsequently it formed a leading work in the collection of Suermondt,

at Aix-la-Chapelle, whence it comes to this country. An etching made while yet the picture was in the hands of the late possessor, was published recently in the April number of the *Gazette des Beaux Arts*. M. Bürger, the chief authority on Rembrandt, writes a critical description of the picture in that journal; and while the article was going through the press he hears, to his astonishment, of the change in ownership; in consequence, he adds a concluding note, to the following effect: "The English, who have a passion for importing all beautiful things, have induced M. Suermondt to cede to them this *chef-d'œuvre* of Rembrandt. What consoles me for this conquest of the English is that at least the picture must always remain visible in a public museum, and will be guarded by very intelligent solicitude." The picture measures seven feet by five feet; it is supposed to have been painted about 1650, but it is without date or name—a strange want in a work by Rembrandt,—and M. Bürger conjectures that the artist's signature may have been painted out, in order to save the picture from the cupidity of the French on their approach to Vienna. The figures are life-size, the style is essentially naturalistic; the colour tertiary, broken and shadowy, and the execution of a rude vigour. Dutch types are dominant, save, perhaps, in the figure of the Saviour, which retains a reminiscence of Italian nobleness. On the opening of the National Gallery, on the 5th November, this work, which ranks in merit with "The Night Watch" at Amsterdam, and the School of Anatomy in the Hague, will be found hung as the centre of thirteen works, which exhibit the early and later styles of Rembrandt with singular completeness.

National Portraits Exhibition.—A second exhibition, in chronological continuation of the first, will open in the spring of next year. It will commence with portraits of the reign of William and Mary. It is also to include, "as supplementary, the portraits of any distinguished persons who were not duly represented in this year's exhibition." The number of works forthcoming is so considerable that the exhibition may possibly be extended over a third year.

Prizes and Honours at the Brussels Exhibition.—The jury has just completed its labours, and announced the prizes awarded to artists contributing to this exhibition. Of the ten gold medals one falls to M. Carrier Belleuse, the French sculptor, and the rest to Belgian artists. The King has conferred a number of decorations on artists. M. Ingres is made Commander of the Order of Leopold, MM. Thomas and J. Stevens, of Paris, M. Robert, of Brussels, and M. Charles Verlat, of Antwerp, Officers; and the following artists Chevaliers of the same order: Messrs. Frith and Stanfield, of London; MM. Daubigny, Charles Jalabert and Schreyer, painters, M. Maillet, sculptor, and M. Auguste Blanchard, engraver, all French artists; MM. Alma Tadema, De Haas, Keelhof, painters; Gustave Simonau, water colour artist and lithographer, and Jacques Wiener, medal engraver, Belgians; and M. Van Muyden, painter, of Geneva. The Exhibition has proved so attractive, that the closing has been adjourned from the eighth to the eighteenth of the present month.

Manufactures.

Metallurgical Industry in Belgium.—The iron works in the district of Charleroi have for this year realised handsome profits, in spite of a slight augmentation in the price of labour, as well as in fuel. Great progress has been made in the manufacture of pig iron. Last year's production may be estimated at about 500,000 tons, of which scarcely 10,000 tons were exported, whilst on the other hand 25,000 tons were imported. Thus, the Belgian pig iron, which formerly served to supply the German and French iron works, is almost entirely used up in its own country. It is not now sufficient even for home consumption; and in general the trade has no cause to be dissatisfied with the reduction of import duties, that are now only 5 francs per ton. All the Belgian pig iron is worked up in the country, and it only goes out in the state of malleable iron. This is of considerable advantage for the blast furnaces, which in this manner are no longer tributaries to foreign markets. This indicates at the same time an extraordinary progress in French trade. Belgium, in 1865, exported 57,000 tons less, and imported 120,000 tons more than in the preceding year. Free trade and the facilities of transport have given an impetus to the mineral districts of France. The situation of the mineral industry of the Charleroi district would leave nothing to be desired if the low price of coal was maintained; but since the end of last year there has been a gradual rise, which begins to press heavily on manufacture. French markets for fuel are only obtainable with an augmentation of 20 to 25 per cent. on those of last year.

Algerian Cotton.—From the recent report of the Marseilles Chamber of Commerce, it appears that France, in 1865, received from Algeria about 4,000 bales of cotton, of a quality such as will readily realize remunerative prices to the grower. The province of Oran produces a long silky cotton, similar to the Sea Island of America, but of greater value, the latter having been sold at 150 fr. the 50 kilogrammes, and Oran at 300 fr., while exceptional parcels found buyers at 550 fr. A remarkable fact in connexion with Oran is that the cotton plant, instead of deteriorating in quality by repeated crops, is much improved by continual culture.

Commerce.

Commerce and Productions of the Republics of Ecuador, New Grenada, and Venezuela.—The principal articles of exportation from these states are, tobacco, gold, from the mines of Antioquici, cotton, medicinal bark, coffee, cocoa, woods for dyeing purposes, and hats, called Panama, whether coming from the interior, or from Guayaquil, in Ecuador. The payment for exports is by bills of exchange on London and Paris at 90 days' date. At Paris the exchange is at par, these states having adopted the French decimal system. Amongst the most important commercial towns of the country are Saint Martha, where nearly all foreign imports are landed; Carthagina, from whence is exported all the India rubber obtained from the immense forests of Darien; Savanilla, that exports to London, New York, and Bremen, tobacco, cotton, vegetable ivory, bullock hides, coffee, and yellow woods; lastly, Rio Hacha, that does a great trade in wood and dye stuffs, called *dividivi*. The merchants of this town obtain these products by means of exchange with the Goagizos Indians, and export them to Havre. The value of exportations from these states may be approximately taken at 50,000,000 of francs, and that for importations at about the same sum, France receiving about about 12,000,000 francs as her share.

The Flax Crop in Antrim.—Mr. A. Gordon, of Cushendun Mills, Larne, in a communication read before the Chemico-Agricultural Society of Ulster, says:—"In compliance with your request, I submit you a few statements relative to the flax crop in the Glens of Antrim. My observations apply only to three of the glens of Antrim,—Glendun, Glenarm, and Glenariff. The soil of these glens is light, sandy, and poor; and in Glendun and Glenarm mica enters largely into its composition in some parts, and where there is a depth of earth of this kind I have seen it produce good crops of flax, especially in a wet season. In the immediate neighbourhood of Cushendun there is a small track of rich alluvial land, where patches of flax are cultivated that would bear comparison with that grown in any other part of the North of Ireland, if it were only treated with the same skill in the cultivation and after management that it in

is in the County Down and some other places. Last year I saw flax grow for the third consecutive season on the same lands without manure of one sort or other. The crop had a good appearance while growing—the yield was about four stones to the peck; but the fibre was greatly inferior in quality to that of the two former years. I state this fact more to show the ignorance that prevails in the science of agriculture, and that adherence to a mere mechanical drudgery and barren formula of traditional precepts, handed down from father to son, rather than to illustrate the flax-growing qualities of the soil. The above observations apply only to Glendun and Glenarm, for Glenariff is as much superior in soil and cultivation as it is in the grandeur of its scenery over the two adjoining glens. The soil of this glen is formed from the debris of the crumbling basaltic rocks that rise, terrace-like, to the height of 1,000 feet or upwards, on either side, and immediately over the limestone stratum. The glen is much better adapted to the cultivation of the flax crop than either of the other two, as the soil in general is richer, and of greater depth. Flax is becoming pretty extensively cultivated in this glen of late years, and is taking the place of the cereal crops, as it is found to be a better paying one. Though some excellent flax is raised on the alluvial lands near the sea, and in the hollow of the glens, that might still be much improved; yet, in general, these glens are unsuitable for an extensive cultivation of this crop, as the lower grounds are of comparatively small extent, and the higher grounds are very poor, light, and deficient in vegetable matter. But besides the poverty and lightness of the soil, there are other obstacles in the way of the successful cultivation of the flax crop in these parts, and that is, the waters. These waters I have found near their sources yield a Prussian blue precipitate with ferrocyanide of potassium. This, I presume, was owing to the presence of a carbonate of the protoxyde of iron in these waters. I strongly suspected the presence of gallic and tannic acids in some of these waters, but was unable to satisfy myself on this point. The flax steeped in these waters I have found invariably hard and dry in the fibre, when dressed, and wanting that soft, silky feel and rich appearance possessed by some flax. I hold the opinion that a knowledge of the chemical ingredients held in solution by waters intended for flax retting, together with a knowledge of those reagents necessary to counteract their injurious influence on the flax, would be of the utmost importance to flax-growers. Some waters, for instance, may contain a carbonate of lime in preponderance over other mineral matters, or it may be an oxide of iron, or perhaps a tannic acid, or some other substance injurious to the retting of the flax. Now, I hold that were the farmers or flax-growers of Ireland in possession of a knowledge of the deleterious matters contained in the waters to which they submit their flax for the purpose of retting, together with the means of treating those matters with the same skill that the physician does his patient, by checking the disease either temporarily or completely removing it, they would then be able more fully to develop the resources of the country in this branch of its staple manufacture, and be in a position to compete with any other country in the cultivation of the flax crop. I am also of opinion that the injurious matters contained in many waters might be neutralized to a great extent, if not altogether removed, by collecting those waters in the steep pond for six or eight weeks before the retting season commences, and by supplying caustic alkalis to the water in the pond a short time prior to putting in the flax to steep. The alkalis, I should think, would have a tendency to soften the waters, promote fermentation, and neutralize any protoxides of iron present. Should Léfébure's system of retting be committed to the public, and should it prove efficacious in every locality where practised, it will certainly be a great boon to every flax-growing country. But may not his system prove most satisfactory in one locality and quite the contrary in another, owing to the different qualities of the waters used in retting in different localities? I am unable to state the acreage of the flax crop sown in the Glens, but I believe it is fully one-fifth less than last year, and looks very much worse than it did at this season last year. The general impression is that it will be very little worth here this season, unless there be a plentiful supply of rain immediately. The long drought has almost scorched the young plants out of root. The recent showers have, however, improved the appearance of the crop very much.

Colonies.

The Import and Export Trade of Melbourne was, in 1851, valued at £25,000,000, but has increased to £28,000,000 in 1864, wool having increased in that period from £734,000 to £3,280,000. The number of cattle in 1851 was 378,000, sheep 6,000,000, the former of which has increased to about 7,000,000 and the latter to 70,000,000. The total area of land under cultivation in 1851 was 52,340 acres, and had increased in 1864 to 507,798 acres. The public revenue has increased from £400,000 in 1851 to an average of £3,000,000.

Land in New South Wales.—The periodical report submitted to the Colonial Parliament by the President of the Board of Lands and Works, shows the change of the occupation of the soil in the colony. Before the Land Act was passed, in 1860, the area alienated comprised 3,944,239 acres, and produced £9,049,131, or an average of £1 9s. per acre. Under the Act of 1860 the selections of country lands extended to 410,600 acres, and averaged £1 0s. 11d. per acre, and 387,642 acres purchased at auction of country lands at an average price of £1 3s. 6d. Under the Duffy Act 701,322 acres were sold at £1 per acre; 661,921 acres were leased to individuals, and 59,992 acres were leased to certificate holders. Under the Amending Act of 1865, 1,827,335 acres were let on lease, the average size of the lots taken being about 230 acres. The result is that 778,278 acres have been alienated, and the greater portion taken, since 1860. On the 1st of January, 1866, 1,342,523 acres were open for selection.

Queensland.—"This colony," says a Brisbane journal, "differs from those of New South Wales, Victoria, and South Australia. The two first have gold-fields upon which they can rely for a certain amount of revenue, and the latter has the Burra-burra copper mines and large agricultural crops. Queensland has hitherto been merely a settlement for squatters, notwithstanding that Government have expended a large amount of money in trying to induce immigration. Last season, although considered by many unfavourable, was the reverse as regards the sugar and cotton cultivation. The crops of the latter were larger than during any previous year, and the samples sent to the local exhibition were themselves a proof of the suitability of this climate, and of the Queensland soil to its growth, and of the favourable prospects which have been realised; and there are many other resources which only require development. Four very important public works have been commenced, all of which are progressing favourably, viz., the dredging of the flats in the river Brisbane; the dredging of the same river near Redbank; the dredging of the river Fitzroy; and the construction of a jetty at Port Denison. The remainder of the timber has left Brisbane, and this undertaking is expected to be finished shortly."

New Zealand Coalfields.—The Nelson coalfields are beginning to grow into importance. At the Grey River the demand exceeds the supply, as all the steamers engaged in the local trade of the West coast prefer this fuel to any other that can be procured from Australia. The coalfields at West Wanganui are about to be worked by a company, the coal having been successfully tried for steam purposes. Cargoes of this coal are now regularly brought to Nelson, and meet with a ready sale.

Obituary.

HERMANN GOLDSCHMIDT, well known for his astronomical discoveries, died on the 29th of August, at Fontainebleau. He passed many years of his life in Paris, and gained reputation as a painter of classic and historic subjects. Possessed of limited means, he stamped his name on the rolls of science by his eminent perseverance. He was the son of a merchant, and was born at Frankfort-on-the-Maine, June 17, 1802. His early years were passed in his father's commercial establishment, but a visit to Holland, when he was thirty years of age, led to his devoting himself to painting, which art he studied with much assiduity under Schnorr and Cornelius. In 1836 he proceeded to Paris, which he made his home, and where he produced a number of fine works. His picture of "Romeo and Juliet" was purchased by the state, and at the annual exhibitions he gained several prizes. Whilst thus engaged he prosecuted astronomical studies and made a reputation amongst men of science by his numerous discoveries and mathematical calculations. About 1847 his attention was accidentally turned to astronomical subjects, which he eventually adopted with great ardour, and the fruits of his researches include the discovery of thirteen minor planets, the list commencing with Lutetia, on the 15th November, 1852, and ending with Panopea, on May 5th, 1861. For these discoveries the Royal Astronomical Society in 1862 awarded him their gold medal. He obtained many prizes and other honours from the Academy of Sciences at Paris and other scientific bodies, who recognised the value of his energetic labours, carried on with very humble apparatus on the sixth floor of the Café Procope. Among these must not be omitted the observation of about 3,000 stars not marked in the charts published by the Academy of Berlin, with the concurrence of the most eminent astronomers of Germany.

Publications Issued.

LIFE OF WEDGWOOD. By Eliza Meteyard. (*Hurst and Blackett.*) Vol. II.—Miss Meteyard, with the publication of the second volume of "The Life and Works of Wedgwood," completes a work to which she has devoted more than ten years. The second volume, both in its text and illustrations, sustains the character won by the first. It may be useful to give notice that information is solicited as to any Wedgwood ware not yet known, especially "choice specimens of encaustic painted on black bas-relief vases," or "fine specimens of enamelled useful ware." Miss Meteyard suggests further appplication of terra cotta ornaments and bas-reliefs to the decoration of "the façades and other parts of houses and buildings." She quotes the fact that Wedgwood endeavoured to induce the brothers Adam, who built the Adelphi, and Sir William Chambers, the architect of Somerset-house, to introduce encaustic plaques into their designs. Such a custom, it is known, prevailed even before the time of Luca della Robbia, in Italy: it is recorded that crusaders coming from Italy caused plates and dishes, brought as spoils from the East, to be inserted in the pediments of Romanesque churches. The authoress desires that "wall linings of terra cotta should do away with" what she is pleased to call "the barbarous taste of the paper-hanger and upholsterer; and floors of exquisite tile work would serve to border the warm-embracing carpet." The second volume ends with an engraving and some account of the "Wedgwood Institute," at Burslem, now in course of erection. In this façade the ceramic arts are boldly used for decoration. The windows, doorways, cornices, and walls will receive colour and detail from the art manufactures for which the Potteries have been so long famous. A frieze of encaustic pictures will set forth the various processes of ceramic manufactures. Portraits of Wedgwood's distinguished friends and contemporaries, as also of celebrated potters of every age, painted in Majolica colours on large plaques, will fill the spaces of the arched window heads, and over the chief entrance panels in jasper ware will be introduced.

Forthcoming Publications.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Nottingham Meeting, August, 1866. Edited by William Tindal Robertson, Esq., M.D. (*Hardwicke*).—This publication will contain a full and authentic report of the Proceedings of the British Association for the Advancement of Science, on the occasion of the meeting at Nottingham in August, 1866. It is understood that great care has been taken to ensure correct reports both of the papers and the discussions, and as far as possible the editor has succeeded in obtaining the assistance of the authors in correcting the reports.

Notes.

A NEW BELT FOR SOLDIERS. — M. Heeremans, a Belgian, has invented a belt for soldiers, which deserves the attention of all interested in military affairs. After an engagement or battle, an idea may be formed of the miserable position of the wounded, who, without timely care and dressing for their wounds, often perish without succour, or from the heats or colds that bring on gangrene. The belt is buckled on as an ordinary belt; it is 1·30 m. in length by 8 centimetres in width. It is lined outside, so as to receive a band of dressing of the same length, which is readily drawn out. Close to the buckle are two india-rubber pockets, containing, firstly, a bandage for a second wound; secondly, lint, plaster, pins, &c. The soldier wears it on his trousers, and the total weight does not exceed 150 grammes, or about 5 ounces. In many cases the soldier would be enabled to dress his own wounds or those of his wounded comrades. Once the wound dressed, which might occupy two minutes, the belt may be used as a great bandage, whether the wound be in the body or leg; if in the arm it serves as a sling. This belt, of so slight a weight, and at a price not exceeding a franc, does not impede the movements of the soldier.

SECONDARY SPECIAL EDUCATION IN FRANCE.—This important branch of education seems to be gaining ground daily. The Academic Council of Strasbourg, in June last, proposed that a certain number of colleges, which exhausted their strength and the resources of the communes in giving imperfect classical education should be converted into establishments for special education. The number of *bourses* (exhibitions) voted by the Conseils-Généraux of the departments in the year 1865, for the new special normal school at Cluny, was 53; this year the number has already reached 72 in the seventy-six councils whose reports have been rendered to the government, so that, with the donations of the Emperor and the central authorities, and pupils whose fees will be paid by their families or friends, the normal school of Cluny will at once assume an important character, and doubtless contribute greatly to the dissemination of sound practical professional training. The college attached to the normal school promises equally well; the eastern and northern railway companies have each created six exhibitions for the children of the employés, and there are already twenty-five candidates for the six exhibitions of the former company. The session of the school and college opens in October. The classic Lycée of Mont de Marsan, at another extremity of France, is being transformed into a model school for special training, and the number of pupils entered under the new regulations already

amounts to more than 130, and many more are expected to join before the opening of the session. The professors of this new model school are already appointed, the scientific collections are being enriched by presents from the museum of the veterinary school at Alfort, from the principal establishments in the capital and the departments, and from private individuals. The Minister of Public Instruction was to preside at the opening of this school.

STATE OF GREECE.—The Marquis de Moustier, the new French Foreign Minister, during a recent stay of a few days at Athens, had an interview with M. Bulgaris, President of the Council of Ministers, at which, while explaining the policy of the Emperor in the East, he observed that Greece had not hitherto justified the expectations of Europe, and that her resources were quite undeveloped. M. Bulgaris replied that Greece was unjustly accused of not having followed the path of progress, and that at the termination of the terrible struggle to which she owed her independence, and which lasted no less than nine years, she remained devastated, ruined, and exhausted. In thirty-six years the Greeks had been able to build considerable cities, clear and cultivate the land, and create a mercantile navy, enjoying the best reputation. During the same period her population had doubled. The Greeks also had made rapid progress in letters, and nearly everybody in Greece could read and write. The Greek merchants held the first rank in the commercial cities of the world, and that by reason of the honesty of their dealings. In a word, said M. Bulgaris, few countries show such considerable and rapid progress as Greece. The country was burdened at its birth with a considerable loan, of which ten millions alone entered the country; and from this reason, as well as the poorness of the revenue, Greece had not been able to make roads. The unsatisfactory state of her finances was solely due to the last revolution, and was not, after all, desperate.

ENTERPRISE IN CALIFORNIA.—A company has been formed in California for the purpose of digging a tunnel in the Sierra Nevada mountains, and through it conveying the clear waters of Lake Tahoe to the channel of a stream, and so across the valleys to San Francisco. It is designed thus to supply a dozen interior towns as well as the larger city with delicious water of great purity, provide the miners with water for carrying on their work during the dry season, and irrigate thousands of acres of land that are now unproductive. The difficulty of the undertaking will be comprehended when it is remembered that the lake is fifteen hundred feet higher than any body of water on earth ever navigated by a steamboat. Col. A. H. Von Schmidt is the engineer by whom the undertaking is to be executed.

THE SPECIAL NORMAL SCHOOL OF CLUNY.—This excellent new establishment, which opens its door this month, is receiving the support of all the friends of education; M. Milne Edwards, the well-known professor of zoology and naturalist, has just presented to the museum of the school his valuable palæontological collection, which includes between three and four thousand specimens, classified and arranged chronologically by the learned professor. A more valuable aid in the study and explanation of geology than this collection of fossil remains, could scarcely have been presented to the new normal school.

TELEGRAPHIC PROGRESS IN FRANCE.—The diminution of the charges for telegraphic messages in Paris as well as in other parts of France and the Continent has produced an enormous increase in the number of messages, and the increase is still growing. The director-general of telegraphs just published the report of the first five months of the present year, and each month exhibits a large increase as compared with the same month of last year. May shows the largest increase, the receipts having been only 436,577 francs in 1865, and 586,332 francs in the present year, an increase of 150,000, or more than one-third in twelve months.

Patents.

From Commissioners of Patents' Journal, October 12th.

GRANTS OF PROVISIONAL PROTECTION.

Artificial fuel—2449—A. F. Stoddard.
Boots, &c., elastic waists for—2383—E. Wall.
Breaks—2435—S. R. Freeman and A. Grundy.
Chronometers—2447—I. Hermann.
Compressed air engines—2377—A. B. B. von Rathen.
Corn, drying—2433—G. Dyson.
Cotton gins, self-acting feeding apparatus for—2441—T. Brace and W. Savory.
Cotton, packing—2437—J. T. Wood.
Cotton, &c., twisting—2324—P. J. Railton and D. Walton.
Cylinders—2061—G. W. Rendel.
Fabrics, waterproofing—2443—J. R. Johnson and F. Gale.
Fibrous materials, carding—2481—H. A. Bonneville.
Fibrous matters, preparing—2431—J. Clark.
Fire-arms, breech-loading—2417—H. Carter and G. H. Edwards.
Fluid, employing the motive power of jets of—2489—M. P. W. Boulton.
Fluids, burning—2471—H. Starr.
Fuel—2473—J. Hamilton.
Hats—2299—J. H. Johnson.
Lace machinery—2461—C. E. Brooman.
Leather goods, cleaning—2429—T. Challinor.
Letters, &c., collecting and delivering—2491—W. Clark.
Liquids, filtering—2451—W. E. Newton.
Looms, picker motions for—2427—W. Clark.
Looped fabrics—2221—H. Carrier and W. V. Copeland.
Metal-founders' blacking—2479—J. C. Sellars.
Metallic ores, smelting—2413—C. W. Siemens.
Overshoes—2475—A. H. Thurgar.
Railway tickets, printing dates on—2455—G. Adams.
Rudders—1498—F. Hewitt.
Scythes—2439—J. G. C. Fussell and W. Wise, jun.
Service pipes, preventing waste of water from—2457—J. Chandler.
Stiles—2437—G. Thring.
Substances, drying—2453—R. Kuntsmann.
Taps—2485—J. H. Johnson.
Tarred ropes, untwisting—2459—W. Hunter.
Thatch—2419—G. O. Gooday.
Types, machines for setting and distributing—2425—W. Clark.
Umbrellas—2411—F. Sutherland.
Vertical shafts, lubricating—2421—J. Marsh.
Woven fabrics, printing and folding—2463—J. Barker.
Yarns, elevating—2465—A. Steven.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

File-cutting machinery—2549—W. R. Lake.
Files and rasps, cutting—2548—W. R. Lake.
Leather binding—2585—G. Haseltine.

PATENTS SEALED.

844. M., W., A., and J. McNab, jun., J. McAusland, and J. C. Fisher.
1038. W. Bond.
1041. J. J. Bodmer.
1045. W. J. Cunningham.
1047. S. Chatwood & J. Sturgeon.
1049. A. Swan.
1050. T. Brittan.
1052. J., C., L., and M. Jefferson, and J. Greenway.
1055. J. Gresham.
1067. C. Richardson.
1068. R. E. Kaulbach.
1073. J. H. Johnson.
1074. J. H. Johnson.
1092. C. M. Barker.
1109. W. Webb.
1147. R. W. Abbotts.
1203. T. Hutton.
1353. W. C. Moore, J. M. Haslam, and J. Robinson.
2001. S. T. Armstrong.
2105. W. R. Lake.

From Commissioners of Patents' Journal, October 16th.

PATENTS SEALED.

1071. E. Ash and T. Whitley.
1079. C. E. Brooman.
1080. C. J. B. King.
1084. J. Dickinson, jun.
1086. W. Bullough.
1088. G. White.
1089. R. Puckering.
1093. C. A. Girard & G. de Laire.
1096. E. Lord and R. Norfolk.
1097. J. Holmes & J. C. H. Slack.
1101. E. Wilson.
1102. R. Hamilton.
1106. D. Evans.
1114. F. E. Woller.
1123. W. Brookes.
1128. J. Macintosh & W. Boggett.
1152. R. Thompson.
1155. E. Burle.
1212. J. C. Pearce.
1297. A. Pocheron.
1876. F. Tolhausen.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

2490. J. W. Goundry.
2506. J. Dodge.
2513. J. Fowler.
2551. F. de Wyldé.
2493. P. R. Jackson.
2503. R. Aitken.
2511. T. C. Craven.
2497. W. T. Bury.
2507. G. Morgan.
2520. W. J. Rideout.
2555. A. Budenberg.
2564. J. Vaughan.
2512. T. Scott.
2526. H. Clayton.
2608. H. Bridson and J. Alcock.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2306. C. F. Beyer.
2345. J. Jack.